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Dr. Torres completed his graduate studies in 1980 at the University of California.

His work focuses on the physiological adaptations of organisms to the pelagic environment. Dr. Torres and his students have approached the study of oceanic organisms from two different perspectives: the vertical and the latitudinal. In the first instance, they compare the adapted characteristics of species living in the deep sea with those living in surface waters. In the second, they compare suites of similar species from widely differing climatic regimes: the subtropics and the Antarctic. By melding the two perspectives they gain a broad-scale understanding of the basic physiological characteristics of oceanic species and the ecological factors that helped to shape them.

Current research projects include: (1) determination of metabolic rates, enzymatic activities and compositional attributes of Antarctic zooplankton and micronekton as a function of season, depth of occurrence, and relationship to the Antarctic ice pack; (2) in-situ measurement of metabolism in gelatinous zooplankton using the Sea Link submersible: (3) the role of air-breathing in the early life history of tarpon; (4) energy utilization in larval fish; and (5) adaptation to salinity and cold temperature in Arctic intertidal crustacea.

Unit I Antarctic Ecology

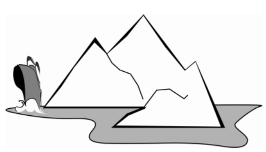
On the cutting edge….
Antarctica is the most extreme continent in terms of climate and topography. The land and water habitats present challenges for the plants and animals that live there. Scientists from the University of South Florida hope to gain a better understanding of some of the Antarctic ice and water food webs by studying the pelagic fish and their adaptations. They want to use this information to study the human impact on this unique ecosystem.

Antarctic Ecology I

Lesson Objectives: Students will be able to do the following:
- Describe an Antarctic ecosystem
- List three ways ice is used as a habitat
- Explain the importance of ice algae in the Antarctic food chain

Key concepts: Southern Ocean, Antarctic Convergence, Antarctic Circumpolar Current, food web, ecosystem, biomass

Antarctic Region

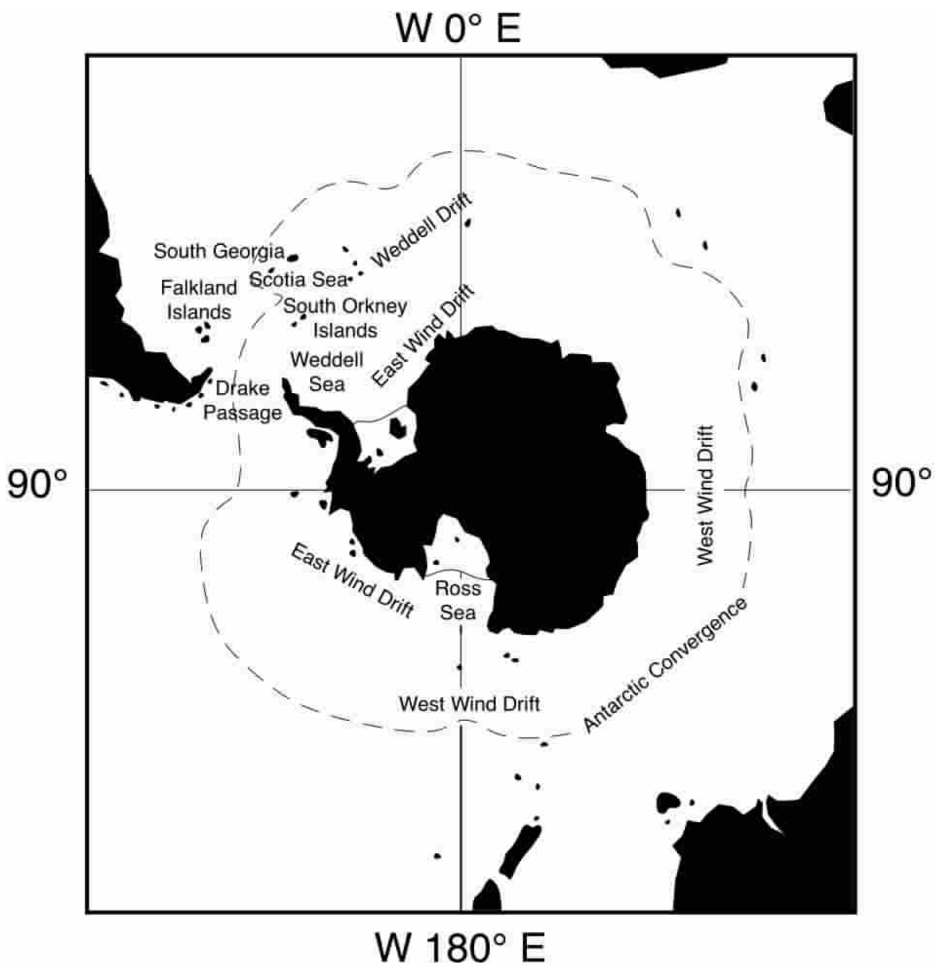


The Antarctic region includes a continent that covers the southern pole and the water that surrounds it. The landmass itself has been separated from the other continents for millions of years and has been gradually cooling to its present temperature. It is a land of extremes, containing high mountain ranges and interior deserts that are subjected to profound changes in day length and seasonal temperatures. This environment is influenced by intense changes in climatic conditions that affect the physical components of the ecosystem and the organisms that live there. The extremes of this continent have allowed only a few types of organisms to live successfully upon this landmass.

The Antarctic land mass is surrounded by the **Southern Ocean**. It is considered one of the most hostile oceans because of its high winds and churning seas. The southern boundary of this ocean is the continental landmass with its narrow **continental shelf** dropping off abruptly in some areas to depths up to 1500 feet. The northern boundary is 60° south latitude. The true Antarctic ecosystem includes all of this area extending to the **Antarctic Convergence**.

The Antarctic Convergence, located in the vicinity of 50° south latitude, is actually a front or a place where water masses of different temperatures meet. In this case, the colder surface water flowing north meets warmer water flowing south. Since the density of water increases as the temperature decreases, the denser cold water sinks beneath the warm water creating a thin icy bottom layer covered by a warmer surface layer. This provides a nutritionally rich feeding zone.

The **Antarctic Circumpolar Current**, or West Wind Drift, carries surface water from west to east around the continent. This current, affected by land mass shape and ocean **topography**, creates an irregularly shaped zone of water with unique properties. The mixing of water both vertically and horizontally sets up a thermal barrier that isolates the Antarctic ecosystem. This thermal barrier results in many **species** that are unique to the Antarctic.

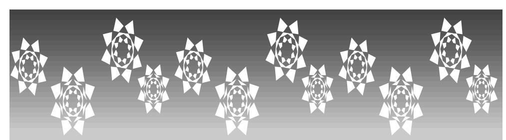


Antarctica and the Surrounding Waters
Adapted from R. M. Laws (1985)

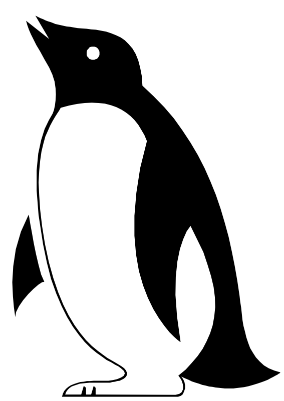
Ice and Water as a Habitat

Most organisms in the Antarctic make their homes in the marine component of the environment that is greatly influenced by the amount and extent of sea ice. Seasonal changes influence the sea ice **habitat** in a couple of ways. During the Antarctic winter temperatures plunge as the sun stays below the horizon causing twenty-four hour darkness in some areas. This severely limits the growth of the microscopic plants found at the base of the Antarctic food chain. Also during the winter, a portion of the ocean surrounding the continent freezes into a large ice pack that doubles the size of the continent. At its maximum extent, this ice pack covers an area one and a half times the size of the United States. The swelling and shrinking of the Antarctic pack ice is the largest seasonal process in the world ocean and is key in the life cycles of the organisms that live there.

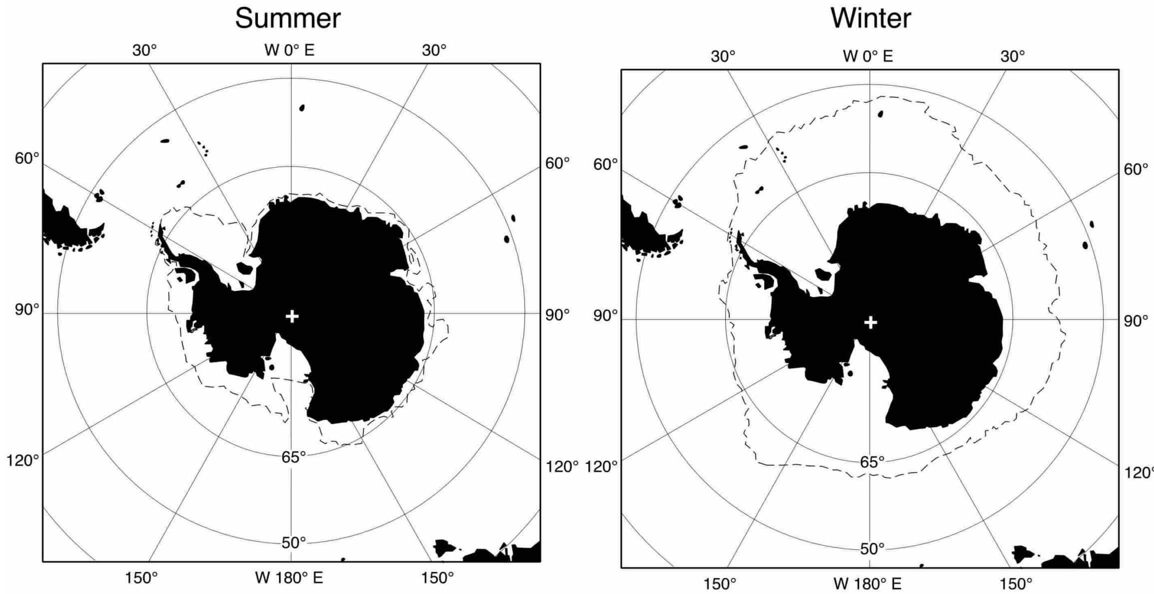
During the Antarctic winter, the surface of the water cools to –1.86 degrees centigrade. At this temperature the seawater begins to freeze, leaving behind the salt as **brine**. During the freezing process, some plankton may become trapped in the ice as it grows into larger and more solid forms. At this point the ice is called **pancake ice** because it resembles stacks of pancakes. As the pancake ice melds together, some of it forms solid chunks called **pack ice**. The floating pack ice, responsible for the change in size of the Antarctic continent, provides three different types of habitat for animals adapted to exploiting this environment. Tiny **plankton** can live within the pack ice. Seals, penguins, and flighted sea birds can use it as a floor. Additionally, it forms a roof over animals swimming in the water.



What are the implications of all of this ice? First remember that the ice is covering the surface of the ocean and floating from place to place helping to cool the atmosphere above and insulate the ocean below. Thick ice prevents sunlight from penetrating the water while moving ice crushes against the landmass causing topographical changes. All of this ice provides extensive habitat as it freezes and thaws throughout the seasons.



Sea Ice Extent



The shaded area represents the Antarctic Continent. The area between the broken line and the continent is the region covered by sea ice. This figure is adapted from satellite passive microwave images of Antarctic sea ice as reported by Zwalley et al. (1983).

The Importance of Ice in Antarctica's Ecology

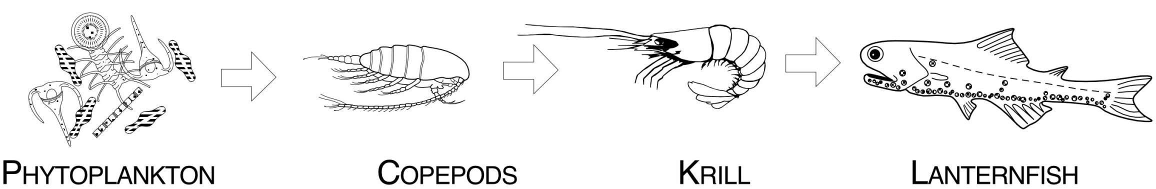
Energy is transferred through every **ecosystem** in the form of food. Whether organisms are **producers** or **consumers**, the acquisition of food is necessary for life. This energy flow can be represented by **food chains**, **food webs** or **food pyramids**.

In addition to the **biotic** factors affecting the energy flow through a system, the **abiotic** factors also contribute to the distribution of the **biomass**. In the Antarctic the life cycles of many animals are tied to the Antarctic pack ice.

The **ice algae** form the base of the food chain. They can be found free living in the water or at the bottom of the ice. Other organisms in turn respond to the cycle of algal growth associated with the change in seasons. During the summer, the algae are abundant; but in the transition seasons of fall and spring, the algae seem to be found only in conjunction with the **sea ice**. This phenomenon affects the abundance and distribution of organisms further up the food chain that utilize these algae.

The Antarctic **krill**, a distant relative of the shrimp you eat, is an important link in the energy transfer in the Antarctic ecosystem. They eat the ice algae and are in turn eaten by animals further up the food chain including fish, seals, and penguins. They are associated with the ice edge throughout their life cycle. The young krill use the underside of the ice as a nursery area. It affords them protection from **predators** within its many cracks and crevices, as well as abundant food in the form of ice algae. In late winter, with limited food available, the older krill also feed upon the ice algae. Their population distribution and size are tied to the amount and extent of the sea ice.

The fish species that feed upon the krill also have to be able to tolerate the temperatures associated with the sea ice. Some of these Antarctic species, such as the ice fish, have developed biological antifreezes that circulate in their blood and prevent ice crystals from forming in the blood stream. Many of these species also use the pack ice as a hiding place to avoid the penguins and seals that use the sea ice as a hunting platform.



Activity: Antarctic Adventure

Antarctica is a land of extremes. It is the coldest and driest place on earth. It is also isolated from the other continents by a great expanse of water. Researchers visiting the Antarctic need to be prepared to stay for long periods of time isolated from the other parts of the world. They have to pack everything they will need for their personal use and scientific research for several months.

Objectives: Students will be able to do the following:
1. Interpret information pertaining to the Antarctic.
2. Use this information to develop an appropriate packing list for a four month stay in the Antarctic.
3. Design traveling gear to hold necessary items.

Materials:
- Paper
- Pencil
- Colored pencils
- Current newspaper articles or other reference materials
- Internet access (optional)

Procedure:
1. Make resource materials such as newspaper articles and books available to students. The following Internet sites also contain great information:
   http://www.marine.usf.edu/icestory2000
   http://www.yourexpedition.com
   http://www.blue ice. com
2. Have students read and discuss this material with regard to the necessities for a four-month trip to the Antarctic.
3. In small groups have students categorize the items they would take on this trip.
4. Have students create lists of items in each category.
5. Now tell students that the number of items they are allowed to take is limited.
6. Have individual students prioritize their items and keep them to the limited number.
7. Have students design Antarctic explorer gear to hold their items. Be sure students draw and color a detailed picture, labeling all pockets etc.
8. Have students explain their design and the factors that were involved in their final packing list decisions.
9. Have students compare and contrast what they did in this exercise to decisions made by real Antarctic explorers.

Possible Extensions:

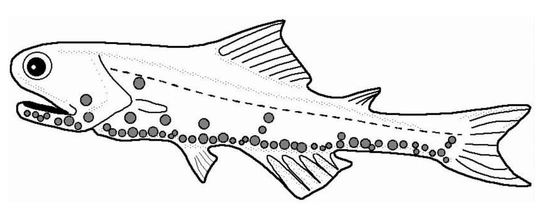
1. Students design outerwear for the trip.
2. Students list the items they would take in just one category, tell how many of each item they would take, and why.
3. Groups collaborate to come up with their design, prioritize, and then finalize their drawing to include the seven (or other number of your choosing) most important items to be included.
4. Groups design gear for a particular person. For instance one group designs gear for a scientist studying pelagic fish, another group focuses on designing gear for the ship's cook. They then compare and contrast items most important for each person.

Student Information: The Antarctic Ecosystem

Imagine a world of ice and water separated from the rest of the continents for millions of years. As the wind blows across the **Southern Ocean**, it chills the air to subzero temperatures. The landmass covering the bottom tenth of the globe is owned by no one.
It contains extreme environments subject to rapidly changing weather conditions. Most of the animals adapted to these conditions are found nowhere else on earth.

The Antarctic **food chain** is unique. At the base of the chain, microscopic floating plants called **phytoplankton** are driven with the wind and currents. They need light to **photosynthesize** yet find themselves caught in the ice crystals turning it to a brownish color. Even though encased in ice, phytoplankton are not protected from the microscopic animals called **zooplankton** that are waiting to eat them. The majority of these grazers are **copepods** that look like tiny aliens from outer space flailing their legs and whipping their antennae. These creatures are not safe either because they will be fed upon by the **omnivorous krill**. These tiny shrimp-like creatures swim in giant schools that turn the water red as they pass. They are easily seen by the birds overhead or by crabeater seals that need a meal. The krill are not safe in the water, either, for the treacherous ice fish or lantern fish with their **luminescent** organs and big eyes are ready to feed.

But why do we care about the plight of the phytoplankton, the krill, or even the ice fish? By studying **ecosystems**, we can understand how we are connected to and influence our environment. As more people travel to the Antarctic for scientific research and recreation, the global community needs information so it can decide what to do with this vast resource and how to protect it.



Chris Simoniello

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Chris started her undergraduate program at Florida International University in Miami as a business law major. After taking a marine invertebrate zoology course, she switched to a biology major. During her undergraduate career she also completed a Certificate Program in Marine Science. She received her degree in 1988.

Following several field seasons with the U.S. Fish and Wildlife Service in Alaska, a stint as a veterinary technician and volunteer at the Miami Seaquarium, and a few years as an analytical chemist, Chris found a program where she could combine the best of all worlds. At the University of South Florida, she is working on her doctoral dissertation in physiological ecology.

Her research focuses on the physiological and biochemical adaptations that enable aquatic organisms to survive in diverse habitats. Chris is particularly interested in mid-water and deep-sea species, so she spends a lot of time at sea. Her longest voyage was 65 days!

When asked what advice she would share with students, Chris replied, “Do what you love!”

Antarctic Ecology II
Penguins and Seals

Lesson Objectives: Students will be able to do the following:
- Indicate the location of Antarctic endemic and circumglobal species on a map
- Identify three categories of adaptations
- Compare and contrast penguin and seal adaptations

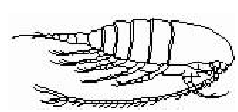
Key concepts: endemic species, circumglobal species, behavioral adaptations, morphological adaptations, physiological adaptations, community, niche

Classification of Adaptations

Organisms of the Antarctic can be divided into the **endemic** and **circumglobal** species. These categories describe the geographic range of organisms. The Antarctic, endemic animals are those that are found exclusively in the Southern Ocean. They will only be found south of 60° south latitude, because they are confined to the Antarctic ecosystem. The circumglobal species are found at all longitudes in waters between 40° south latitude and 40° north latitude. They may be found in a variety of habitats.

Both groups of organisms have **adapted** to this harsh environment by finding diverse solutions to some common problems. They use a combination of **behavioral**, **morphological**, and **physiological adaptations** to meet their needs. Behavioral adaptations describe how the animal lives. For instance in what season will penguins lay their eggs, how many will be laid, and who will take care of them. Morphological adaptations describe the appearance of an organism. This includes their size and shape. It is the reason a penguin looks like a penguin. Physiological adaptations describe body processes. For instance, seals provide adequate oxygen to their bodies during long dives by shutting down oxygen flow to their extremities.

If we look at a typical Antarctic **food chain**, we can see how organisms have adapted to their situation. For instance, we find a combination of circumglobal and endemic species at the lower levels of the Antarctic food chain that are **ectothermic** or “cold blooded”. The body temperature of these organisms depends on the surrounding water. These include the copepods, krill, and fish.



The microscopic **phytoplankton,** consisting mainly of **diatoms**, drift along with the currents **photosynthesizing** while the sun’s energy is optimum. **Copepods,** comprising the major portion of the **zooplankton,** use their oil reserves to float in the water. As the winter days grow shorter copepods become **dormant** to conserve energy while their main food source of phytoplankton are in short supply. **Krill** become opportunistic, scouring the bottom of the sea ice looking for **plankton**. If plankton are in short supply, they live off their fat reserves. As the winter grows longer, the krill slow their living processes as they rise and fall through the water column. They pass through several larval stages of development until they reach maturity over a two-year period. The krill all the while are excreting **ammonia** into the water, which is used by the phytoplankton to restore their nitrogen reserves. The krill swarm together in masses and in turn are eaten by a variety of organisms at the higher **trophic** levels. These include the ice fish, an endemic species that contains no **hemoglobin** in its blood so it appears white in color. The lantern fish, with its big eyes and **luminescent** organs contains antifreeze to keep its blood from freezing.

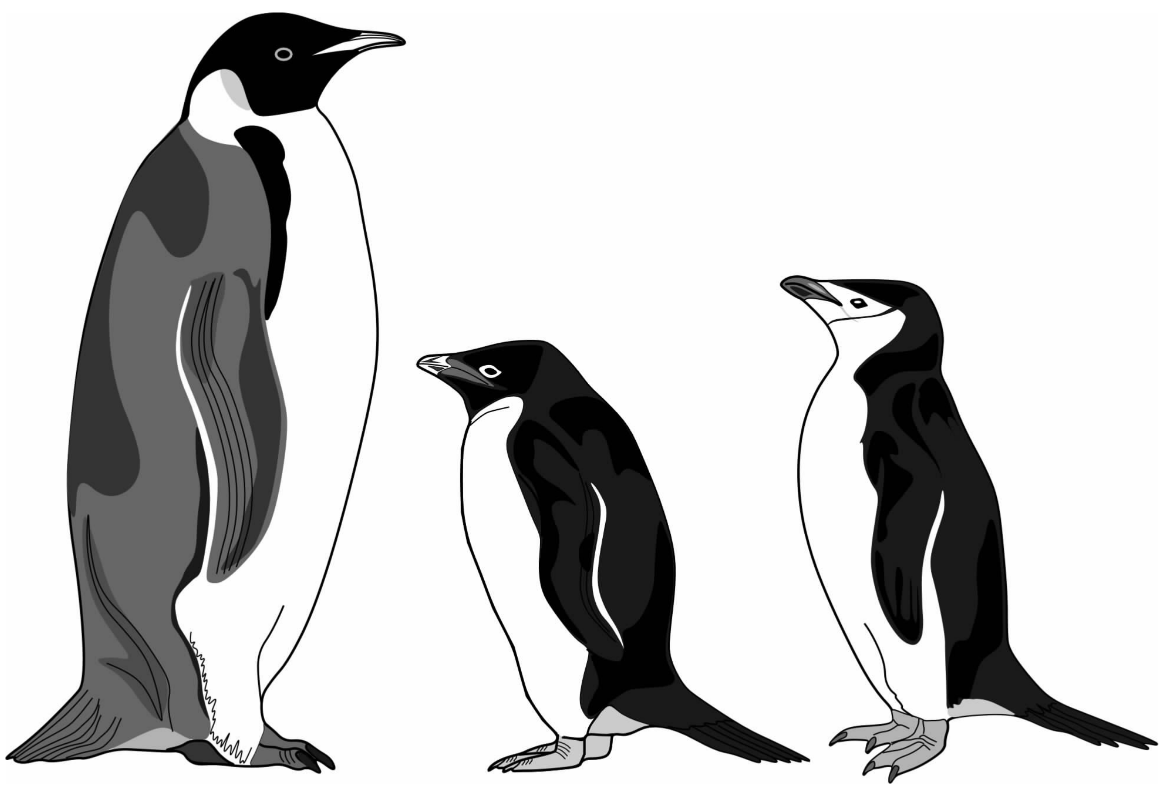
At the upper levels of the food chain, we find the endothermic or “warm-blooded” animals that include humans, whales, and seals. These organisms can maintain body temperatures significantly different from their environment. A closer look at three species of penguins and six species of seals will give insight into how these animals meet their needs.

Penguin Adaptations

Morphological adaptations among penguins are the most noticeable. All penguins are well adapted to the cold and for them this may be an advantage. They have a thick layer of blubber that acts as an insulator and a food reserve. They are also well adapted to the water environment in which they spend much of their time. Waterproof feathers keep them dry after long swims in the ocean. Good underwater vision and streamlined bodies allow for swift movement through the water. Since their wings are used for swimming and not for flying, they are shaped like flippers. Their webbed feet act as paddles. Unlike flying birds, they have solid bones that add extra weight to help them when they dive. Their coloration is also designed to protect them in the water environment, with dark feathers on their backs and light feathers on their chests. This is called **counter shading** and **camouflages** the penguin while it is in the water. When seen from above, they blend with the water. When viewed from the depths they blend with the ice or sunlight.

Behavioral adaptations describe how penguins relate to each other within their group as well as how the whole group relates within its **community**. Behavioral adaptations also help to define the **niche** or job each species occupies. This in turn contributes to their abundance and range. For instance, the emperor penguins do not build nests for their chicks, but the male holds the egg on his feet and warms it with a brood pouch, staying with it for up to nine weeks. The Adelie penguin, however, produces two eggs about a month apart and the adults share the care taking duties. Other behavioral differences include the habitat region occupied by each group, their diet preferences, and the space requirements among individuals in the group.

Physiological adaptations are difficult to see since they occur at the molecular level, but their results are fairly obvious. For example, penguins eat foods that have a high salt content and **regurgitate** it for their young. The bodies of their young are already adapted to this diet, with kidneys that help to excrete excess salt. Scientists are still studying the exact mechanism of these and other physiological adaptations.



Emperor Penguin **Adelie Penguin** **Chinstrap Penguin**

Seal Adaptations

Little is known about the life cycle of seals because they live on the thick pack ice and over-winter in the icy Antarctic waters. Morphologically, seals can be identified by their size, coat color, and the absence or presence of external ears. They are generally found separately or in small groups, except during the breeding seasons. Scientists are very interested in their behavioral adaptations related to their range. Their **migrations** are followed by satellite, and recorded with **transmitters.**

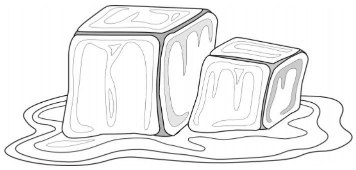
Seals also have adapted morphologically to their environment. Their bodies, though not designed for fast movement on land, allow them to move gracefully in the water. Their large eyes are designed for keen underwater vision, and their fur color helps them to blend well with the snow on the ice floes that they call home. Size also plays a part in their survival. Killer whales feed upon the smallest and most rare Ross seal. Tooth shape and size plays an important part in the seal life cycle. The Ross seal has needle like teeth for spearing fish and squid that are the main components of their diet. The Crabeater seals have lobed teeth that help them to strain krill from the water. They actually get their name from the red colored **scat** that they produce. The Leopard seal, the main **predator** of young penguins, has long sharp teeth for tearing. The Weddell seal uses its teeth to chew holes through the ice in order to live underwater in the wintertime.

Behaviorally, seals are an interesting group. Studies have been limited due to the isolated life styles of some species. For instance, the Crabeater seal occupies the outer edges of the ice pack. One mother and pup occupy an ice floe so the mother identifies her pup spatially because no other pups are within her territory. The males stand guard and actually prevent the mother from leaving the ice floe during certain stages of chick development.

The diving response of seals represents a physiological adaptation. Seals shut down the circulation to their extremities and concentrate oxygen in the heart and lungs where it is most needed. During this process they must also be concerned with the build up of carbon dioxide and nitrogen within their bodies.

Each species has a unique role and spatial distribution within the ecosystem that allows each to coexist and maximize resources.

Activity: Antarctic Insulators



Animals living in a particular habitat are suited to that environment. Various animals have chosen different ways to meet their needs. Penguins live in cold regions where they spend much of their time in the water. They have developed effective insulation to help regulate their body temperature in and out of the water.

Objectives: Students will be able to do the following:
1. Prepare experiments to simulate penguin insulators and waterproofing.
2. Compare and contrast the results of their experiments.
3. Determine the most efficient design.
4. Support their conclusions with data.

Materials:
- Containers with leak proof lids
- Water
- Thermometers
- Insulating materials such as newspaper, starch noodles, plastic bubble wrap, fake fur, air filled plastic bags, etc. (Make duplicates available.)
- Masking tape or duct tape
- Paper
- Pencil

Procedure:
1. Give each student (or group of students) a container filled with water, a leak proof lid, and masking tape. (Water temperature is up to the discretion of the teacher.)
2. Have students measure and record the temperature of the water in the container.
3. Have students fasten the lid tightly onto the container.
4. Have students choose an insulating material.
5. Have students wrap the container with the insulating material and secure it with tape. (Be sure the lid can still be easily removed.)
6. Have all students place their containers in the same area for a specified amount of time. (Containers could remain at room temperature or they could be put into a refrigerator or freezer.)
7. After the time has elapsed, have students measure the temperature and record the results.
8. Have students determine the amount of temperature change and record.
9. Use the results from the duplicate insulators (all jars wrapped in paper, etc.) to determine an average temperature change.
10. Use the following as topics for discussion:

Which insulator appears to work the best?
What affected the results?
Why are the data from duplicate insulators different?
What were the variables involved?
Compare and contrast this experiment to one that scientists would do.
(Discuss replications and statistically valid numbers, etc.)
Compare and contrast to real penguin adaptations.

Possible Extensions:

1. Repeat using a different core material such as ice.
2. Use different thicknesses of the various materials.
3. Use a combination of materials.

Activity: Antarctic Waterproofing

Penguins as flightless birds spend much of their time associated with the ice and water in the Antarctic region. In addition to insulating their bodies against the cold temperatures, they must also find ways to keep themselves dry while conserving energy. They have adapted efficient waterproofing techniques using their feathers and the oils associated with them.

Objectives: Students will be able to do the following:
1. Identify waterproofing materials.
2. Compare and contrast the effectiveness of various waterproofing materials.

Materials:
- Transparent container (a 5 gallon aquarium is ideal)
- Water (enough to fill the container)
- Feathers
- Cooking oil
- Solid shortening
- Plate or shallow pan
- Plastic bags

Procedure:
1. Fill the transparent container with water.
2. Have a student coat a feather with oil.
3. Have the student put the feather into the water
4. Observe and record the results.
5. Repeat the experiment.
6. Have a student coat a feather with the solid shortening using a plastic bag as a glove.
7. Have the student put the feather in the water.
8. Observe and record the results.
9. Repeat the experiment.
10. Have students try the experiment varying the thickness of the shortening.
11. Have students use various measured amounts of oil on the feather.
12. Have students compare and contrast the results for each type of waterproofing.
13. Use the following as topics for discussion:
    What are the advantages and disadvantages for each type of waterproofing?
    How does efficiency increase or decrease with more waterproofing material?
    How do the results of this experiment relate to actual penguin adaptations?

Possible Extensions:

1. Use a variety of oils and solid fats. Compare and contrast their suitability. Have students infer that the oil penguins produce most effectively meets their needs.
2. Design an insulated item that is also waterproof. Set up some additional criteria such as weight and size restrictions.
3. Give students the same criteria and materials to design the best penguin.
4. Have students work in groups to design a penguin with additional adaptive needs such as diving requirements.

Student Information: Antarctic Adaptations

Adaptations allow animals to survive in a particular environment. We can separate adaptations: physical characteristics, types of behaviors, or body processes. Animals use a combination of these adaptations to become best suited to their environment. Scientists are particularly interested in studying the **native** species in the Antarctic including the penguins and seals to uncover some mysteries regarding their abundance and distribution.

Scientists today are focusing their studies on the health, nutrition, genetics, and **migrations** of these two groups. To study seals, researchers must come in contact with these animals. They must be well trained, because they will be approaching animals that can weigh several hundred pounds. When researchers find an animal, they place a bag over its head. This calms the animal so the researcher can take measurements and other needed data. They measure the animal's length and **girth** (waist), and weigh it on a spring scale. They also check its teeth and take a blood sample. Skin and hair samples are also collected. Next they measure the thickness of the blubber using an **ultrasound.** Blood samples that are taken let researchers know if the animal has been exposed to any particular diseases. Also it can be used in genetic studies to determine how closely some of the **species** are related. Before the animal is released, a **transmitter** is fastened to its fur. Scientists can then follow the animal as it travels.

By studying penguins and seals, researchers hope to find out some clues to their successful inhabitation of the Antarctic. Perhaps these studies will unlock keys to their abilities to adapt to this harsh environment that will, in turn, lead to new technologies or insight into disease control.

Antarctic Vocabulary

Abiotic-nonliving parts of the environment (for example light and temperature)

Adapt-to become suited to an environment over millions of years

Adaptations-characteristics that allow an organism to live in its environment

Ammonia-a colorless, pungent gas composed of nitrogen and hydrogen from animal waste (NH_3=ammonia gas; NH_4=ammonium ion)

Antarctic Circumpolar Current-surface ocean current that surrounds Antarctica and flows from west to east

Antarctic Convergence-An irregular ocean ring that surrounds Antarctica. In this zone, the cold waters from the southern ocean converge (meet) with warmer waters from oceans to the north.

Behavioral-pertaining to the actions of an organism

Biomass-the total mass of living matter within a given environmental area

Biotic-the living things in the environment, such as plants and animals

Brine-water saturated with salt

Camouflage-blending in with the environment

Circumglobal-found throughout waters between 40° south and 40° north latitude

Community-a group of plants and animals living and interacting with one another in a specific region

Consumer-an organism (usually an animal) that feeds on plants or other animals

Continental shelf-the area adjacent (next to) a continent or around an island, usually extending from the low-water line to the depth at which the bottom depth increases steeply

Counter shading-coloration that is dark on parts of the body surface that are usually exposed to the sun and light on parts usually in shade

Copepod-microscopic, aquatic crustacean having an elongated body and a forked tail

Diatom-microscopic, one celled plant having cell walls made of silica

Dormant-existing in a resting stage

Ecosystem-a community of living organisms

Ectothermic-an organism that regulates its body temperature by exchanging heat with its environment; cold-blooded

Endemic-an organism that naturally occurs in the environment where it is found

Food chain-the order of transfer of matter and energy from one organism to another in the form of food

Food Pyramid- a graphic representation of the food chain with producers on the bottom level and consumers on the subsequent levels

Food web-a series of overlapping food chains

Girth-the distance around something; circumference

Habitat-an area or environment in which an organism normally lives or occurs

Hemoglobin-the iron containing pigment in red blood cells

Ice Algae-aquatic, photosynthetic organisms associated with the Antarctic ice pack

Krill-any of the small, pelagic, shrimp-like crustaceans of the family Euphausiidae

Luminescent-producing light using chemical energy

Migration-the act of moving from one environment to another

Morphological-pertaining to the form and structure of organisms

Native-a life-long inhabitant of an area

Niche-the particular area and function occupied by an organism within a habitat

Omnivore-an organism that feeds on both plants and animals

Pancake Ice-pancake-shaped ice formed from seawater

Pack ice-used interchangeably with sea ice and ice pack; this is the final stage of sea ice formation; continued thickening and growth of ice results in large, thin sheets of ice floating at the ocean surface.

Plankton-small or microscopic plants and animals that float and drift in water

Phytoplankton-minute, free-floating aquatic plants

Photosynthesize-plants making their own food through a chemical process; the process uses carbon dioxide, water, nutrients, and sunlight

Physiological-pertaining to the functions, activities, and processes of living organisms

Population-a group of organisms of the same kind occupying an area

Predator-an animal that hunts for food

Producer-an organism that is able to make its own food from inorganic substances; a plant - photoautotroph, or some bacteria - chemoautotrophs

Regurgitate-vomit

Scat-animal feces

Sea Ice- ice made from seawater

Southern Ocean-the southern extensions of the Atlantic, Pacific, and Indian oceans that surround Antarctica

Species-a group of closely related organisms that can interbreed

Topography-surface features of a place or region

Transmitter-an electronic device that gives out signals that can be followed

Trophic level-a group of organisms that occupy the same position in a food chain

Ultrasound-taking a picture using sound waves

Zooplankton-very small or microscopic aquatic animals

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